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ABSTRACT

The ways in which teachers' cognitions about classroom practice vary with the developmental level of the children they teach and the subject matter taught were studied through interviews with 40 teachers. Participants were 8 teachers of kindergarten and grade 1, 10 teachers of grade 2, 11 teachers of grade 3, and 11 teachers of grades 4, 5, and 6. Interviews contained a set of questions to determine teachers' views of effective procedures for encouraging children's study and retention of spelling and mathematics materials. A set of 13 strategies was formulated to summarize the kinds of study activity teachers said they suggested to children and parents. Analysis indicated that strategies were more likely to be described during discussions of spelling instruction than in remarks about mathematics. Mention of particular strategies varied as a function of grade and subject matter. Teachers valued the development of strategies and attributed the success of high achievers to their use of study strategies, their reliance on assistance from other persons, and their ability. However, poor performance was seldom attributed to failure to use strategies effectively. Results indicate that teachers were sensitive to developmental changes in children across the elementary years as reflected in the strategies they suggested. A table summarizes the strategies suggested, and a bar graph illustrates teacher attributions for the success of high achievers. (SLD)

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A Developmental Perspective on Teachers' Cognitions about Memory Strategies and Metacognition in Classroom Teaching

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Our interest in how changes in teaching practices occur over grade level arises from a consideration of research in the areas of memory strategy and metamemory development and also our own previous work on classroom practices. Peterson (1988) has described a recently emerging view of the teacher as a "thoughtful" professional, engaged in higher order learning, decision-making, thinking, and judgment in the course of classroom interaction. As Peterson notes, "teachers' thoughts, cognitions, judgments, thinking, and learning processes become important dimensions in studying the teacher and teaching... "(p.6). Peterson describes cognitional knowledge as an awareness on the part of the teacher of the "mental processes or facilities by which learners acquire knowledge through classroom teaching" (p.7). The aim of the present study was to learn about the ways in which teachers' cognitions about classroom practice vary with the developmental level of the children they teach and with the subject matter taught.

Interviews were conducted with 65 teachers of children in grades K-6. For the present study, only those 40 teachers who reported their teaching activities in both spelling and mathematics were considered. Participants were 8 teachers at the kindergarten-first grade level, 10 teachers of second grade, 11 third-grade teachers, and 11 teachers of grades 4, 5, and 6. The interviews were conducted as part of a larger project concerned with the ways in which teachers encourage the use of cognitive strategies for memory and problem-solving during classroom study.

The interview included a set of questions designed to elicit teachers' views of effective procedures for encouraging children's study and retention of material that they needed to learn in order to succeed in a content area. Questions probed the teacher's view of memory processes, beneficial study activities, and goals of instruction in both spelling and math.

Transcripts of the interviews were scored for mention of study strategies that the teachers said they suggested to their students or to the parents of these children. Study strategies were categorized according to a scheme developed by Hart, Leal, Burney, & Santulli (1985), used previously to summarize strategy suggestions that teachers were observed to make during instruction (Table 1). The twelve categories in this scheme included rote learning (writing, saying, or otherwise studying information repeatedly), along with strategies of a higher level of complexity, requiring greater cognitive involvement of the child (such as elaboration, transformation, image formation, use of aids for problem-solving) and metacognitive strategies (such as self-testing and checking activities, instruction in memory knowledge or metamemorial awareness). An additional category that was derived from the interviews, though rarely seen in observations, involved the use of organizational schemes to simplify the amount of information to be learned. Thus, a set of 13 categories was used to summarize the kinds of study activities that teachers said they suggested to children and parents.

Results of the study are organized to address two broad questions: First, we wanted to determine what study or learning strategies teachers of different grade levels expected of their students in working on math and spelling work, and secondly, we were interested in finding out whether teachers place value on strategies as a tool for successful performance. Mention of strategy suggestions for study in two domains was evaluated by means of ANOVAS involving Grade Level, Subject matter (either math or spelling) and strategies (13 different strategies). Analysis indicated that, overall, strategies were more likely to be described during teachers' discussions of spelling instruction than during their remarks about math instruction.

Mention of particular strategies varied as a function of both grade and subject matter. Therefore, we evaluated each strategy for grade and subject differences. A number of strategies were mentioned more often in teachers' descriptions of activities supporting spelling than in their descriptions of math instruction. Teachers suggested rote strategies (for example, writing the words repeatedly, etc.) more often for spelling than math. A trend for a Grade X Subject matter interaction reflected a somewhat greater subject-matter difference in Grades K-1 than at later grades. It may be that while children are using rehearsal strategies in learning spelling words at the early grades, they learn about numbers by representing them through use of manipulatives (such as finger, counters, etc.). At the later grades, there appears to be more emphasis on memorizing math facts by rote means.

Also mentioned more often for spelling than arithmetic were several higher-order strategies including elaboration (Example: To differentiate homonyms "meat" and "meet," remember that "meat" has the word "eat" in it), deduction (Example: Look at pictures that accompany the text to figure out the story), organizational strategies, and use of general aids (such as a dictionary). Teachers also were more likely to report efforts to promote self-testing and to increase children's metamemory in spelling than in arithmetic instruction.

Only two strategies were mentioned more often in reference to arithmetic than to spelling. These were specific aids for problem solving and memory (for example, using counters or fingers in subtraction problems), and transformation (transforming difficult problems into simpler ones). Mention of these two strategies in each subject matter area varied over grade, as indicated by significant Grade X Subject interactions. Specific aids were rarely used in spelling instruction; for math, they were mentioned by all teachers of Grades K-1, by 95% of the teachers at Grades 2-3, and by 50% of the teachers at grades 4 and above. Transformation strategies were only mentioned in discussion of arithmetic instruction, and showed increased mention over grade level; 8% of the teachers at grades K-1, 48% of teachers of grades 2-3, and 86% of teachers of grades 4-6). This reflects teachers' sensitivity to the development of number concepts in children. Young children are learning about the meaning of numbers and operations, and therefore, are more concrete in representing number with manipulatives. However, at the later grades, children

can manipulate numbers on a more abstract fashion, which is reflected in the teachers' frequent mention of transformation strategies.

Differences across grade, independent of subject matter, were shown for the mention of two strategies. Organizational strategies were mentioned most often by teachers of kindergarten and first grade children, with decreasing mention at the later grades. This may reflect task factors in which subject units at the early grades are chunked in smaller units of material. Interestingly, mention of efforts to instruct metamemory were made most often at grades 4-6, with less frequent mention at the earlier grades. This parallels research findings that childrens' metacognitive skills accelerate during the later elementary school grades, and shows that teachers are aware of this development.

The second aim of the study was to determine the value teachers place on use of strategies for learning. To address this question we considered the attributions that teachers made for the success or lack of success in the learning of children in their classrooms. Teachers' attributed the success of high achievers to their use of study strategies, to their reliance on assistance from the family or other persons, and to the child's ability (Figure 1). Analysis showed that the kind of attributions made varied with grade level, but not by subject matter, for the 31 teachers for whom attributes could be coded. Among teachers of grades K-1, success was attributed to strategy use and family help, rather than to ability. At grades 2-3, teachers most often mentioned strategy

use, with lesser use of ability and family aid. Among teachers of Grades 4-6, success was attributed to ability, strategy use, and family assistance (no differences existed in the means). Therefore, teachers appear to place much value in strategy use, attributing children's success to cognitive processes they can influence by their teaching.

The lack of success of low-achieving children in the teachers' classroom was also attributed to a variety of factors, including the ineffective use of strategies for learning, a lack of ability, a lack of help from parents, and a lack of effort in studying. Analysis, based on the coding of 36 teachers who discussed reasons for low achievement, indicated that teachers used these attributes differentially. Although no grade or subject differences were found for the attributions, lack of ability was most often mentioned, with lack of effort and lack of family aid also mentioned frequently. Failure to employ effective strategies was least often mentioned. Unfortunately, these teachers rarely attributed poor school performance to ineffective strategy use, a skill they can teach, although they saw strategies as helpful to learning. The teachers may not have perceived themselves as effective at helping low achievers and thereby attributed the children's difficulties to ability, something largely beyond their control.

In conclusion, teachers showed sensitivity to the development of strategies and place value on their use. In classroom observations, we have previously found behavioral evidence that teachers take into account developmental changes

in children across the elementary school years, as reflected in the strategies they suggest to children (Moely, Hart, Santulli, Leal, Johnson-Baron, Rao, & Burney, 1986). The present findings are congruent with those derived from observational data, in suggesting that teachers are sensitive to developmental changes in children's cognitive processing capabilities.

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TABLE 1
Classification of Teachers' Strategy Suggestions

1. *Rote Learning*

Rote learning strategies are instructed for simple repetitive learning. Children are told to rehearse stimuli verbally or to write, look at, go over, study, or repeat the stimuli in some other way. The children may be instructed to rehearse items just once, a finite number of times, or an unlimited number of times. Rote learning strategies do not include any explicit activities that would add meaning to the stimulus or cause it to be processed to a deeper level or in terms of more extensive associative relationships.

2. *Elaboration*

The elaboration strategy is instructed for use with stimulus materials that generally do not have much intrinsic meaning to children, such as the definition or pronunciation of words. Children are instructed to use elements of the stimulus material and assign meaning by, for instance, making up a phrase or sentence, making an analogy, or drawing a relationship based on specific characteristics found in the stimulus material.

3. *Attention*

These strategies are suggested by teachers to direct or maintain children's attention to a task. For example, teachers may instruct children to "follow along" or "listen carefully" during lessons.

4. *Specific Attentional Aids*

This strategy is similar to the attention strategy, but children are instructed to use objects, language, or a part of their body in a specific way to maintain orientation to a task. Although these aids are employed in a specific way for the attentional task, they may have other uses ordinarily.

5. *Transformation*

Transformation is a strategy suggested by teachers for transforming unfamiliar or difficult problems into familiar or simpler ones that can then be solved more easily. Transformations are possible because of logical, rule-governed relationships between stimulus elements. Teachers identify these relationships and tell children either that a problem can be rewritten or that it can be reformulated if the method of solution is related or derived from rules and procedures learned previously. Due to the emphasis on logical, rule-governed relationships, this strategy is usually suggested in mathematics.

6. *Deduction*

In deduction, children are instructed to use their general knowledge, in combination with any clue from the material that seems helpful, to deduce and construct the correct answer. Teachers might direct children to use contextual information (e.g., pictures accompanying a text or parts of the text) or to analyze the item into smaller units (e.g., looking for root words, analyzing words phonetically).

TABLE 1 *(Continued)*

7. *Exclusion*

This is a strategy to help children answer test or workbook questions even if they don't know the correct answer initially. Children are told to eliminate incorrect options systematically, either by doing the problems they know first and then trying to match questions and answers that are left over or by trying out all possibilities and selecting the one that seems correct.

8. *Imagery*

This strategy usually consists of nonspecific instructions to remember items by taking a mental picture of them or to maintain or manipulate them in the mind. It also refers to visualizing procedures or characters.

9. *Specific Aids for Problem Solving and Memorizing*

This strategy involves the use of specific aids in problem solving or memorizing. Even though these aids may have other uses, the teacher instructs one specific application of them. Teachers may give explicit instructions on how to use the aids in the task at hand. Thus, children are instructed to use objects, food items, body parts, or assigned reading materials in learning and memory tasks. For example, teachers often tell children to use blocks or other counters to represent addition or subtraction operations in a concrete way.

10. *General Aids*

In contrast to specific aids, teachers recommend the same general aid for a variety of different problems. These aids are designed and used to serve a general reference purpose. Children often have prior training in their use and, once familiar with them, are expected to utilize them without further explanation. Examples include the use of dictionaries or other reference works.

11. *Self-Checking*

Teachers instructing this strategy suggest that children check their work for errors before turning it in. It includes procedures children can use on their own to make sure they are doing a task correctly. Teachers may also suggest that children test themselves or have someone else test them. Or children might be encouraged to keep track of all steps involved in a task so that they can later identify where they made a mistake. The instructions for this strategy are often not specific, but rather a general remark to "check" the work.

12. *Metamemory*

Teachers instructing this strategy tell children that certain procedures will be more helpful for studying and remembering than others, and sometimes teachers may also explain why this is so. The strategy frequently includes giving hints about the limits of memory, asking children about the task factors that will influence ease of remembering, or helping them understand the reasons for their own performance. Teachers may ask children how they can focus memory efforts effectively or what they can do to remember. Teachers also tell children that they can devise procedures that will aid their memory or indicate the value of using a specific strategy.

FIGURE 1

TEACHERS' ATTRIBUTIONS FOR THE SUCCESS OF HIGH ACHIEVERS